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# Discovery of andesite tuffs with graphite from the Vaigat Formation of south central Nûgssuaq: stratigraphical implications

**Asger Ken Pedersen, Lotte Melchior Larsen & Finn Ulff-Møller**

During helicopter reconnaissance in 1987, one of us (F. U.-M.) found patches of poorly exposed tuffaceous rocks within the Vaigat Formation on the west side of Ilugigsoq valley north of Auvfarssuaq (fig. 1). Subsequent investigation under the microscope revealed that the tuff consists of graphite-rich andesite very similar to the most abundant tuff type described from the Abraham Member of the Agatdal Formation by Pedersen (1978). The discovery of the new locality with this rare rock type led to a helicopter-based reconnaissance in the Ilugigsoq and Qilakitsoq valleys in the summer of 1988 by two of us (A. K. P. & L. M. L.) in order to trace this possible marker horizon and put it into a stratigraphical context. Similar tuffs were found at two localities described below. Graphite andesites are known from other localities on Nûgssuaq and Disko, and notes on these are also given below.

## *North-west side of Ilugigsoq*

On the mountain side about 1 km south-east of a 1613 m high peak (fig. 2) a layer of conspicuous grey tuffaceous sediment occurs within a sequence of subaerial picrite lava flows from the Vaigat Formation. The layer crops out intermittently over a distance of several kilometres along the northern west side of the Ilugigsoq valley. Fig. 3 shows a preliminary section through the Vaigat Formation in this area. Here the Vaigat Formation below the sediments consists of, in ascending order, a more than 140 m thick lower hyaloclastite horizon, *c.* 45 m of subaerial picrite lavas, a *c.* 25 m thick upper hyaloclastite horizon, and *c.* 30 m of subaerial picrite lavas on which the sediment horizon is situated. The sediment horizon is about 35 m thick, and its grey colour is due to disseminated graphite. The sediment consists of a large number of horizontal beds of redeposited tuffs with varying clast sizes and very variable degrees of sorting. The maximun clast size is about 2 cm. A particularly erosion-resistant set of beds (fig. 4) occur in the interval 15–20 m above the base of the sediment, and these crop out to form a graphite grey bench on the mountain slope. This bench is quite characteristic when seen from a distance. In the poorly exposed upper few metres of the sediments there are

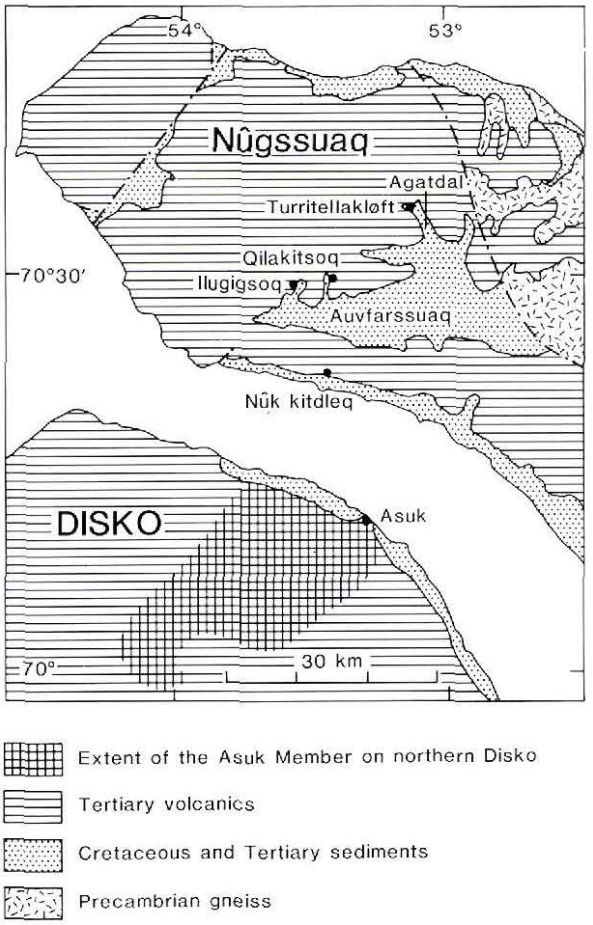


Fig. 1. General geology of Nûgssuaq and northern Disko. Localities described in the text are indicated by dots.

small exposures of claystone with scattered fragments of plant fossils.

Petrographically the clasts of the few samples already investigated comprise two igneous rock types and very minor high-temperature metamorphosed sediments. Orthopyroxene-porphyritic andesite with graphite is the dominant rock type. The groundmass of the andesite clasts varies in crystallinity from clear colourless glass to very fine-grained microcrystalline rock. Associated with the andesite are graphite-bearing plagioclase xenocrysts and graphite-spinel-plagioclase rocks derived from shale by high temperature sediment-magma reaction.

The second igneous rock type present is picrite which mostly forms sharp-edged glass clasts with olivine pseudomorphs and chromite; however, crystalline picrite fragments are also common. The matrix is partly smectite and partly carbonate.

## *Qilakitsoq*

Field work in a small gully ('Enkeltkløft' of Floris, 1957) transecting the eastern side of the inner part of the Qilakitsoq valley led to the discovery of a sequence of redeposited graphite-andesite tuffs near the base of the Vaigat Formation. This locality was first noticed by *Floris (1957) as a greyish-green coarse non-fossiliferous* tuff. The base of the tuff horizon is not exposed, but scattered exposures of black shale in 'Enkeltkløft' indicate that the tuff horizon is very close to the base of the Vaigat Formation here (fig. 3).

The tuffaceous sediments are at least 8 m thick and are composed of fairly coarse beds with up to 5 cm clasts

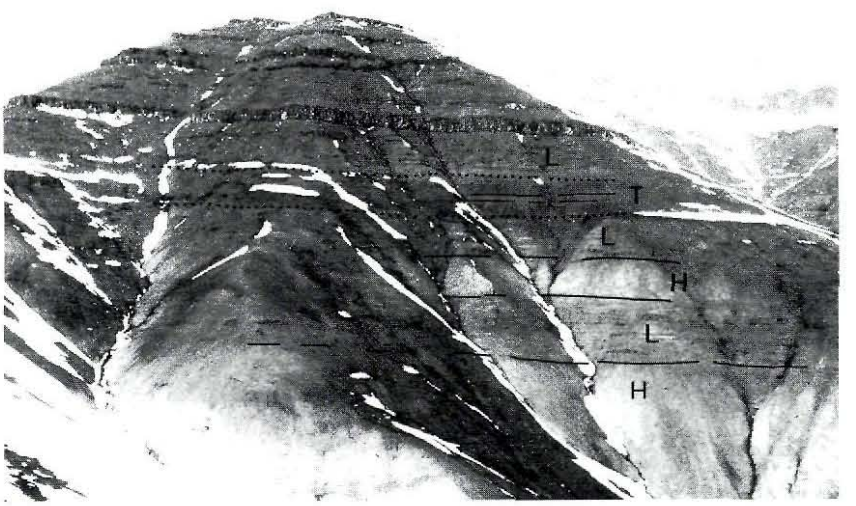


Fig. 2. The west side of Ilugigsoq valley 1 km south-east of a 1613 m high peak. The horizon of tuffaceous sediments with graphite-andesite (T) is 35 m thick. It occurs within a sequence of subaerial picrite lavas (L) below which are seen two horizons of picritic hyaloclastite (H) interspersed with a sequence of subaerial picrite lavas (L).

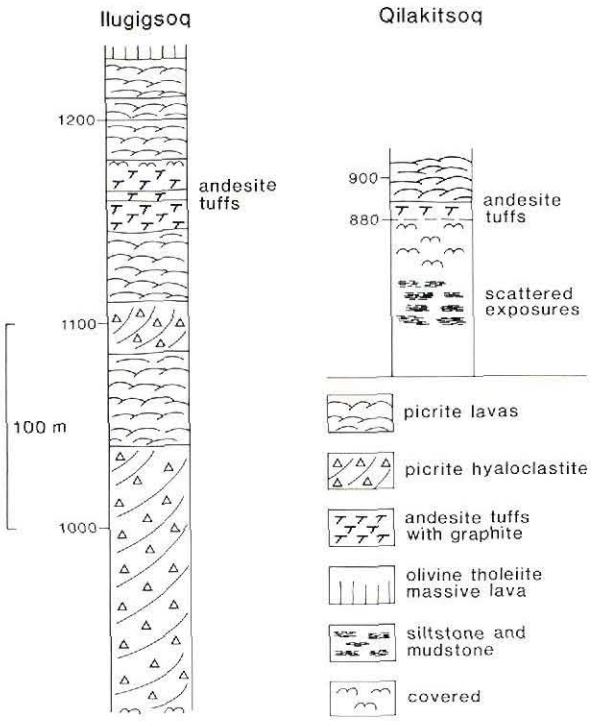


Fig. 3. Schematic sections through parts of the Vaigat Formation at Ilugigsoq and Qilakitsoq, showing the positions of the tuffaceous sediments with graphite-andesite.

alternating with more fine-grained layers. A horizon about 3 m below the top contains up to centimetre sized well-rounded and polished clasts of several types of volcanic rocks, yet to be investigated. The dominant component in the tuffaceous sediment is orthopyroxene-porphyritic andesite with graphite, while clasts of picrite are second in importance. The tuffs are very similar to those described above from the Ilugigsoq valley.

The tuffs are overlain by a sequence of subaerial grey to light brownish weathering basalts which are strongly olivine porphyritic.

## *Other localities with graphite-rich andesite*

*Turritellakløft, Agatdalen.* The Abraham Member of the Agatdal Formation (Rosenkrantz, 1970) consists of mudstones and siltstones in which a large number of tuff horizons are intercalated. A few of the tuff horizons are of feldspar-phyric tholeiitic basalt, and several are of olivine-microporphyritic graphite-andesite. However, the dominant tuff type is orthopyroxene-porphyritic graphite-andesite with subordinate clasts of picrite glass (Pedersen, 1978), petrographically very similar to the tuffs from Ilugigsoq. Field observations by A. K. P. in 1985 indicated that most or all of the tuffs in Turritellakløft are redeposited by water.

*Nûk kitdleq, south coast of Nûgssuaq.* At Nûk kitdleq a prominent graphite-andesite lava flow with native iron occurs which was erupted from a local source. At the base of the lava there are scoria heaps of orthopyroxene-porphyritic graphite-rich andesite (Larsen & Pedersen, 1988). The strongly vesiculated scoria is subaerial and has been extensively altered by circulating water and later weathering. Petrographically it is strongly related to the tuffs from Ilugigsoq.

*Asuk, northern Disko.* The Asuk Member of the Vaigat Formation at the type locality of Asuk is a sequence of strongly reduced lavas and subaqueous breccias (Steenstrup, 1883; Pedersen, 1985). Within this sequence a mudstone horizon occurs which is up to a few metres thick and which contains several tuff horizons up to a few centimetres in thickness. One of the tuff horizons is an orthopyroxene-porphyritic graphite-andesite with subordinate clasts of picrite glass, petrographically strikingly similar to the tuff in Ilugigsoq. Microprobe analyses of fresh glasses indicate a close chemical similarity between the andesite tuff at Asuk and those in the Abraham Member.

## *Stratigraphical implications*

It is important for our studies of the development of the volcanism in West Greenland to obtain firm correla-

Fig. 4. Well exposed erosion-resistant beds in the middle part of the sequence of tuffaceous sediments with graphite-andesite at Ilugigsoq.

tion between as many volcanic members and their time-equivalent sedimentary members as possible. This is particularly so when the sediments can be dated by their content of marine fossils.

The occurrences of petrographically strikingly similar tuffs containing both orthopyroxene-porphyritic graphite-andesite and picrite at one single level in the lower part of the Vaigat Formation at several localities on Disko and Nûgssuaq lead us to the conclusion that they can all be assigned to the Asuk Member (Pedersen, 1985). This correlation can be extended to include the similar tuffs of the Abraham Member in the Agatdal Formation.

The graphite-rich andesite lava and scorias from Nûk kitdleq have earlier been correlated with the Asuk Member on the basis of lithology (Larsen & Pedersen, 1988).

In conclusion, we can now extend the Asuk Member of the Vaigat Formation from northern Disko across the Vaigat Strait into southern Nûgssuaq and along the northern part of the Auvfarssuaq valley.

The fact that the Asuk Member tuffs in Ilugigsoq overlie more than 250 m of volcanics while they are near the bottom of the volcanic pile in Qilakitsoq 6 km east of Ilugigsoq, and are interbedded with a marine shale sequence in Agatdalen 16 km north-east of Ilugigsoq, has implications for the tectonic evolution of the basin which will be pursued in future work.

The extension of the tuffs of the Asuk Member into the marine fossiliferous sediments of the Abraham Member of the Agatdal Formation will lead to a much needed palaeontological dating of a well-defined, widespread and mappable volcanic unit formed in the early part of the development of the volcanic province of West Greenland.

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# New geological investigations in eastern Disko: redeposited volcanoclastic sediments with rhyolite from the Nordfjord Member


**Lotte Melchior Larsen and Asger Ken Pedersen**


During field work in 1988 in eastern Disko we encountered redeposited volcanoclastic sediments with acid rocks at several localities between Rensdyrdalen and Charles Polaris Dal within lava sequences from the Nordfjord Member of the Maligât Formation. Some of the sediments were only observed during helicopter reconnaissance of steep inaccessible walls and corries, while other sites provided detailed information and samples through field visits. Fig.1 shows the area with newly discovered acid volcanic rocks in eastern Disko. Localities 1 and 2 denote localities investigated in some detail.

In north-western Disko peraluminous rhyolite tuffs and conglomerates with almandine-bearing rhyolite blocks occur as widespread but minor deposits in the Nordfjord Member (Pedersen, 1977; Hansen & Pedersen, 1985; Pedersen & Pedersen, 1987). The acid rocks contain graphite and scarce sediment xenoliths and they